

CLAIMS

What Is Claimed Is:

1. An implantable cardiac lead comprising:
a lead body having a proximal end and a distal end, the proximal end of the lead body carrying a connector assembly connectable to the implantable medical device and comprising a first and a second terminal contact; and
a plurality of electrodes carried in spaced- apart relationship along the distal end of the lead body, said plurality of electrodes comprising a distal electrode, a proximal electrode and an intermediate electrode positioned between the distal and proximal electrodes, the distal and proximal electrodes being connected together and electrically connected to the first terminal contact and the intermediate electrode being electrically connected to the second terminal contact.
2. The lead of claim 1 in which:
the intermediate electrode is positioned approximately midway between the distal and proximal electrodes.
3. The lead of claim 1 in which:
the distal electrode comprises a tip electrode and the proximal and intermediate electrodes comprise ring electrodes.
4. The lead of claim 1 in which:
the plurality of electrodes comprises three ring electrodes.
5. The lead of claim 4 further comprising:
a tip electrode disposed distally of the three ring electrodes, said tip electrode being electrically connected to a third terminal contact on the connector assembly.

6. The lead of claim 1 further comprising:
a cardioverting/defibrillating electrode disposed along the distal end of the lead body proximally of the proximal electrode, the cardioverting/defibrillating electrode being electrically connected to a third terminal contact on the connector assembly.
7. An implantable cardiac lead comprising:
a lead body having a proximal end and a distal end, the proximal end of the lead body carrying a connector assembly connectable to the implantable medical device;
at least three electrodes carried in spaced-apart relationship along the distal end of the lead body, the at least three electrodes comprising a distal electrode, a proximal electrode and an intermediate electrode positioned between the distal and proximal electrodes;
a first electrical conductor enclosed within said lead body and electrically coupled to the distal and proximal electrodes; and
a second electrical conductor enclosed within said lead body and electrically coupled to the intermediate electrode.
8. The lead of claim 7 in which:
the intermediate electrode is positioned approximately midway between the distal and proximal electrodes.
9. The lead of claim 7 in which:
the distal and proximal electrodes are electrically connected together at a node point located within the distal end of the lead body, the first electrical conductor connecting said node point with said first terminal contact on the connector assembly.

10. The lead of claim 7 in which:
said at least three electrodes comprise a tip electrode and two ring electrodes.
11. The lead of claim 7 in which:
said at least three electrodes comprise ring electrodes, the lead further comprising:
a tip electrode and a third electrical conductor connecting the tip electrode with a third terminal contact on the connector assembly.
12. The lead of claim 7 further comprising:
a cardioverting-defibrillating electrode carried along the distal end of the lead body proximally of the third electrode; and
a third electrical conductor within the lead body electrically coupling the cardioverting-defibrillating electrode with a third terminal contact on the connector assembly.
13. An implantable cardiac pacing and sensing system, the system being adapted to reject sensed far-field signals, the system comprising:
a lead for transmitting electrical signals between an implantable medical device and selected body tissue in the heart, the lead comprising a lead body having a proximal end and a distal end, the proximal end of the lead body carrying a connector assembly connectable to the implantable medical device and the distal end of the lead body carrying a plurality of electrodes disposed in spaced-apart relationship along the distal end of the lead, the plurality of electrodes including a distal electrode, a proximal electrode and an intermediate electrode disposed between the distal and proximal electrodes; and
an implantable medical device comprising a differential circuit having a plurality of inputs, the plurality of electrodes being electrically connected to respective inputs of said differential circuit, the

differential circuit having an output providing a signal representing the difference between a first signal and a second signal, the first signal representing the difference between the magnitudes of the sensed signals generated by the distal and intermediate electrodes and the second signal representing the difference between the magnitudes of the sensed signals generated by the intermediate and proximal electrodes, the output signal being substantially devoid of far-field signals.

14. The system of claim 13 in which:
the intermediate electrode is positioned approximately
midway between the distal and proximal electrodes.
15. The system of claim 13 in which:
the distal electrode comprises a tip electrode and the
intermediate and proximal electrodes comprise ring electrodes.
16. The system of claim 13 in which:
the plurality of electrodes includes a tip electrode and each
of the distal, intermediate and proximal electrodes comprises a ring
electrode.
17. The system of claim 13 in which:
the differential circuit comprises a first, a second and a third
differential amplifier;
the distal electrode is electrically connected to a first input of
the first differential amplifier;
the proximal electrode is electrically connected to a first
input of the second differential amplifier; and
the intermediate electrode is electrically connected to a
second input on each of the first and second differential amplifiers, the
first and second differential amplifiers each having an output electrically
connected as an input to the third differential amplifier, the third differential

amplifier having an output providing a signal containing the second spatial derivative of a far-field signal incident upon the electrodes, said second spatial derivative being substantially zero.

18. A method of rejecting sensed far-field signals incident upon the electrodes of a cardiac pacemaker lead, said lead having a distal end carrying a plurality of spaced-apart electrodes including a distal electrode, a proximal electrode and an intermediate electrode positioned between the distal and the proximal electrodes, said electrodes generating signals including said far-field signals, the method comprising the steps of:

generating a first signal representing the difference between the magnitudes of the signals generated by the distal and intermediate electrodes;

generating a second signal representing the difference between the magnitudes of the signals generated by the intermediate and proximal electrodes; and

generating a third signal representing the difference between the first and second signals, the third signal being substantially devoid of said far-field signals.